Simultaneous anion and cation exchange chromatography of whey proteins using a customizable mixed matrix membrane

Syed M.Saufi[ab]*; Conan J.Fee*[a]

[a]Biomolecular Interaction Centre and Department of Chemical and Process Engineering, University of Canterbury, Private Bag 4800, Christchurch 8020, New Zealand

[b]Faculty of Chemical and Natural Resource Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

ABSTRACT

Membrane chromatography can overcome some of the limitations of packed bed column chromatography but preparation of adsorptive membranes usually involves complex and harsh chemical modifications. Mixed matrix membranes (MMMs) require only the physical incorporation of an ion exchange resin into the membrane polymer solution prior to membrane casting. An advantage of MMMs not previously exploited is that resins with differing adsorptive functionalities can be conveniently embedded within a single membrane at any desired ratio. This presents the opportunity to customize an adsorptive membrane to suit the expected protein profile of a raw feed stream e.g. bovine whey or serum. In this work, a novel mixed mode interaction MMM customized to extract all major proteins from bovine whey was synthesized in a single membrane by incorporating 42.5 wt% Lewatit MP500 anionic resin and 7.5 wt% SP Sepharose cationic resin into an ethylene vinyl alcohol base polymer casting solution. The mixed mode MMM developed was able to bind both basic and acidic proteins simultaneously from whey, with binding capacities of 7.16 ± 2.24 mg α-lactalbumin g^{-1} membrane, 11.40 ± 0.73 mg lactoferrin (LF) g^{-1} membrane, 59.21 ± 9.90 mg β-lactoglobulin g^{-1}membrane and 6.79 ± 1.11 mg immunoglobulin G g^{-1} membrane (85 mg total protein g^{-1} membrane) during batch fractionation of LF-spiked whey. A 1000 m^2spiral-wound membrane module (200 L membrane volume, 1 m^3 module volume) is predicted to be able to produce approximately 25 kg total whey protein per h.

KEYWORDS:

Membrane chromatography; Mixed mode interaction; Whey protein; Mixed matrix membrane

REFERENCES

1. E. Klein, J. Membr. Sci. 179 (2000) 1.
2. K. Saito, S. Tsuneda, M. Kim, N. Kubota, K. Sugita, T. Sugo, Radiat. Phys. Chem. 54 (1999) 517.
3. C. Charcosset, J. Chem. Technol. Biotechnol. 71 (1998) 95.
4. R. Ghosh, J. Chromatogr. A 952 (2002) 13.
5. T. Kawai, K. Saito, W. Lee, J. Chromatogr. B 790 (2003) 131.
6. M.E. Avramescu, Z. Borneman, M. Wessling, J. Chromatogr. A 1006 (2003) 171.
7. M.E. Avramescu, M. Girones, Z. Borneman, M. Wessling, J. Membr. Sci. 218 (2003) 219.
8. M.E. Avramescu, Z. Borneman, M. Wessling, J. Membr. Sci. 322 (2008) 306.
9. M. Lu, D. Lin, Y. Wu, J. Yun, L. Mei, S. Yao, Biotechnol. Bioprocess Eng. 10 (2005) 128.
10. D. Gao, D.-Q. Lin, S.-J. Yao, J. Chromatogr. B 859 (2007) 16